TechCast A Virtual Think Tank
Tracking the Technology Revolution

TechCast Article Series

Accelerating Change

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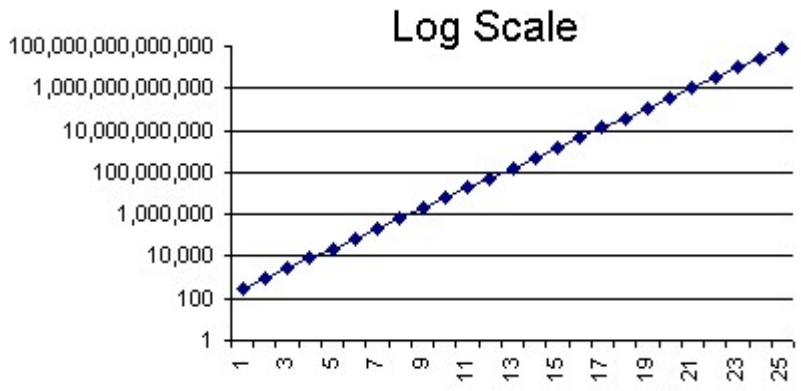
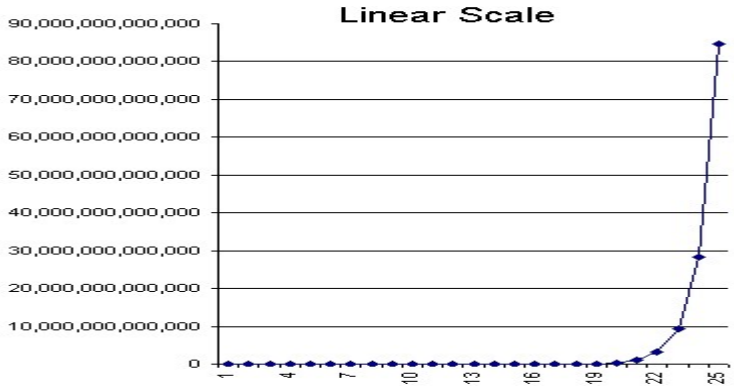
"An analysis of the history of technology shows that technological change is exponential... There's even exponential growth in the rate of exponential growth... The twenty-first century will see almost a thousand times greater technological change than its predecessor..." Ray Kurzweil*

When people think of a future period, they intuitively assume that the current rate of progress will continue for future periods. But the growth of technology is exponential, not linear. Therefore they dramatically underestimate the power of future technology.

Since biological growth maybe easier to understand than technological growth, this article will give an illustration of biological growth. Let's assume that 100 people decide to have large families. Six children per couple on average each 40-year generation.



On the Log Scale there is a steady exponential growth from 300 children in the first generation, to 900 children in the second generation, to 2700 children in the third generation, etc. To nearly 85 trillion at the end of the 25th generation (1000 years). On the Linear Scale, however, the same exponential growth data only begins to appear in the 20th, 21st and 22nd generations. Then becomes obvious in the 23rd generation and really explodes in the 24th and 25th generations. Note: the linear chart would look somewhat similar if plotted to only 12 generations!



The same thing can happen with technology. For example: the use of Photovoltaic solar cells is growing rapidly, but it is hardly noticed because the total power generated is a very small percentage of total electrical power generated in the world. If the current exponential growth rate continues, however, solar cells maybe generating more power than thermal electrical generating plants at some point in the future (approximately 2025, or sooner if goes into double exponential growth).

We tend to overestimate what can be achieved in the short term (because we tend to leave out necessary details), but underestimate what can be achieved in the long term (because exponential growth is ignored). This exponential growth is based on a rich model of diverse technological processes. As more is known about a specific technology, more people start working on the technology. As a specific technology becomes more cost effective, more resources are often deployed to speed up development.

The ever accelerating progress of technology gives the appearance of approaching infinity when viewed as nearly vertical on a linear scale. Can this pace of technological progress continue to speed up indefinitely? The simple answer is yes, when a person is creative and looks at things from a log scale rather than a linear scale. Human beings are remarkably resilient and adaptable. As exponential growth utilizes more resources, more creativity is needed to come up with new, expanded resources. Of course progress in any

one area is seldom constant. Often there are setbacks and periods of time when progress plateaus, followed by spikes of rapid development.

In the population example above, as the population grows, resources become stretched. So creativity is needed. Often the basic knowledge needed to solve the problem is simple. But the application of the knowledge (working out the details) could be more of a challenge!

More food is needed as the population grows. So we need to find enough food for everyone. The basic knowledge is that there is a mutual symbiotic relationship between plants and animals (including human beings). Plants use the solids, liquids and gases (CO_2) we excrete and we use the oxygen and food provided by plants. So we need to grow more plants to feed an ever growing population, and to clean up our wastes...

More energy is needed, so we need to use our creativity to come up with more energy. The basic knowledge is that there is a wealth of energy available. We just need to figure out how to liberate this energy and put it to use in a safe, economical & ecologically friendly manner...

More room is needed for all the people. The basic knowledge is that there is a whole universe out there waiting to be explored and populated by human beings! We just need to learn how to adapt the environment in space to our needs, and/or how to adapt ourselves to the environment in space.

There are any number of other issues that need to be addressed. Creative human beings will step up to the challenge!!

Note: This article is reprinted from
http://www.friendlyinnovators.com/mn/20080410.htm

Note 2: It may take a couple of hours to read Kerzweil's "The Law of Accelerating Returns," but it will be well worth your time.
http://www.kurzweilai.net/meme/frame.html?main=/articles/art0134.html